

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
2 May 2002 (02.05.2002)

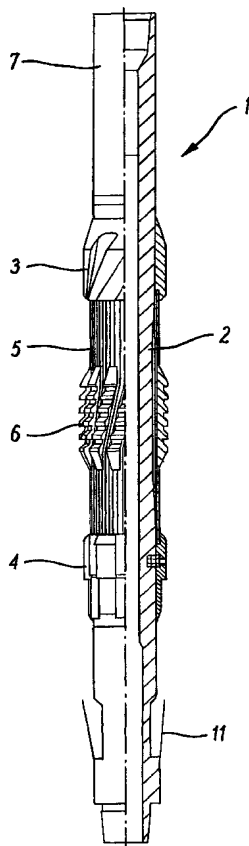
PCT

(10) International Publication Number
WO 02/35055 A1

- (51) International Patent Classification⁷: **E21B 37/02**, 27/00 (72) Inventor; and
(75) Inventor/Applicant (for US only): **HOWLETT, Paul, David** [GB/GB]; 234 North Deeside Road, Cults, Aberdeen AB15 9PB (GB).
- (21) International Application Number: PCT/GB01/04742
- (22) International Filing Date: 26 October 2001 (26.10.2001) (74) Agent: **KENNEDYS PATENT AGENCY LIMITED**; Floor 5, Queens House, 19 St. Vincent Place, Glasgow G1 2DT (GB).
- (25) Filing Language: English
- (26) Publication Language: English (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (30) Priority Data: 0026460.6 27 October 2000 (27.10.2000) GB
- (71) Applicant (for all designated States except US): **SPS-AFOS Group Limited** [GB/GB]; Arnhall Business Park, Westhill, Aberdeen AB32 6TQ (GB).
- (72) Inventor: **TELFER, George**; 19 Grosvenor Place, Aberdeen AB25 2RE (GB).
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: COMBINED MILLING AND SCRAPING TOOL



(57) Abstract: A downhole tool (1) for providing the dual role of cleaning and milling within a well-bore casing or liner is described. In an embodiment scraper blades (6) are mounted on a body (2) together with a milling sleeve (4). Additionally, a centraliser sleeve (3) is incorporated as is a filter and/or junk basket for collecting debris is dislodged from the casing or liner during the cleaning and milling operation. The milling sleeve (4) can be locked onto the body (2) while the cleaning members e.g. scraper blades (6) may be free floating around the tool (1).



WO 02/35055 A1



patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

1 Combined Milling and Scraping Tool

2

3 The present invention relates to a combined milling and
4 cleaning tool intended for use in downhole environments.

5

6 It is a common procedure during the completion of a well
7 to line the newly drilled bore with casing or liner, the
8 latter typically being used near the production area of
9 the bore. Casing, which is usually made of heavy steel
10 piping, is used to prevent collapse of newly drilled bore
11 segments and contamination of the oil or gas reservoir
12 contained therein. Typically the casing or liner is run
13 into the bore from the surface and held in place by
14 introducing cement between the external surface of the
15 casing or liner and the internal surface of the wellbore,
16 with each section of the bore being drilled with
17 consecutively smaller drill bits and then lined with
18 proportionately smaller casing or liner sections.

19

20 It will be appreciated that after cementing the casing or
21 liner in place, it is often necessary to clean the
22 interior of the casing or liner to remove obstructions
23 such as burrs or lumps of cement which remain within the
24 tubing after the cementing procedure. A commonly used

1 cleaning tool, well known to the art, is a casing scraper
2 which incorporates blades typically made of a resilient
3 material such as steel. The blades are used to scrape
4 the interior surface of the casing or liner.

5

6 Milling tools are also well known in the art and are used
7 to "dress off" the polished bore receptacle liner top in
8 a new wellbore. Milling removes burrs, and grinds the
9 polished bore receptacle to allow smooth and easy entry
10 of subsequent tools through the liner. Milling tools are
11 also commonly used to remove casing present in a wellbore
12 if said casing is damaged in any way. Milling tools
13 provide a cutting or grinding action and are necessarily
14 formed from a material which is hard enough to cut or
15 grind the liner top, which is a machine steel tube.
16 Often, the tool is produced with carbide inserts as this
17 material is hard enough to mill casing or liner steel.

18

19 Historically when completing a bore using a scraper and
20 milling tool, the scraping tool is run into the wellbore
21 on a work string to clear the interior of the casing.
22 This first tool must then be removed or "tripped" from
23 the bore before the milling tool can be run to tidy up or
24 "dress off" the liner top. As a consequence, the cost
25 and time taken to finish the bore is increased as it is
26 necessary to perform two trips down the well.

27

28 Previous attempts to run milling tools and scrapers into
29 a wellbore at the same time have encountered problems, as
30 it is usual for the combined milling and scraping action
31 to dislodge and create additional debris within the
32 casing and liner. This is typically suspended in the
33 well fluid in the bore and negates much of the cleaning
34 which is carried out. It has therefore still been

1 necessary when carrying out a combined operation to run a
2 second trip down the well to clean the wellbore before
3 production is commenced.

4

5 It would be very desirable to be able to run a cutting
6 and a milling tool together in one operation, eliminating
7 at least one trip into and out of the borehole to finish
8 said bore, as the beginning of profitable production will
9 not be delayed.

10

11 It is an object of the present invention to provide an
12 improved tool for use when completing a downhole
13 wellbore. In particular is an object of the present
14 invention to provide a tool, which can carry out milling
15 and scraping functions at the same time.

16

17 According to the present invention there is provided a
18 downhole tool for mounting on a work string, wherein the
19 tool comprises an elongate body having a plurality of
20 cleaning members, and wherein the tool also comprises
21 means for milling casing or liner.

22

23 Preferably the tool also comprises means for cleaning
24 well fluid.

25

26 Optionally said means for cleaning well fluid is a junk
27 basket.

28

29 Alternatively said means for cleaning well fluid may be
30 filtration equipment.

31

32 Typically the cleaning members are scraper blades.

33

1 In the preferred embodiment the tool has a first and
2 second sleeve.

3
4 Preferably the first sleeve acts as a stabiliser for the
5 work string within the wellbore.

6
7 Preferably the second sleeve is a milling sleeve.

8
9 Preferably the tool has a floating component located
10 between said first and second sleeve, wherein the
11 floating component is free to move in a radial direction
12 relative to the elongate body within predetermined limits
13 set by the first and second sleeve.

14
15 Preferably the first and second sleeve have female
16 receiving means for receiving the floating component.

17
18 Typically the plurality of cleaning members are supported
19 on the floating component.

20
21 Preferably the centraliser sleeve is mounted by ball
22 bearings that allow for the work string to rotate
23 relative to the sleeve.

24
25 Preferably the milling sleeve is mounted by one or more
26 lock studs that lock the milling sleeve both axially and
27 rotationally with respect to the elongate body.

28
29 Example embodiments of the invention will now be
30 illustrated with reference to the following figures in
31 which:

32

1 Figure 1 shows a cross-section of a combined scraping and
2 milling tool in accordance with the present invention;
3 and

4

5 Figure 2 is a close-up of the locking system, which fixes
6 the milling sleeve to the combined scraping and milling
7 tool shown in Figure 1.

8

9 Figure 3 shows a cross-section of a combined scraping and
10 milling tool having a junk sub.

11

12 Referring firstly to Figure 1, the combined scraping and
13 milling tool is generally depicted at 1. The tool 1
14 comprises an elongate body 2 having a first upper 3 and
15 second lower 4 sleeve, and is run into a wellbore (not
16 shown) which is lined by casing and liner, mounted on a
17 work string 7.

18

19 The upper 3 sleeve of the tool 1 acts as a centraliser to
20 maintain the tool 1 or work string 2 in a central
21 position within the wellbore, whilst the lower sleeve 4
22 is a milling sleeve. Typically the milling sleeve is
23 comprised of carbide inserts which are impregnated into a
24 steel sleeve, which are hard enough to mill or grind the
25 liner top in the wellbore. On rotation of the work
26 string the milling sleeve 4 smooths the entrance to the
27 liner top polished bore receptacle.

28

29 The tool 1 also comprises a floating component 5 between
30 the upper 3 and lower 4 sleeve. The floating component
31 is a lantern which supports a plurality of scraper blades
32 6. The scraper blades 6 scrape the casing which is near
33 to and directly above the polished bore receptacle. It
34 will be appreciated from Figure 1 that the scraper blades

1 are mounted in close proximity to where milling of the
2 liner top takes place.

3

4 Figure 2 shows a section of the locking system which
5 holds the milling sleeve 4 to the tool 1 in more detail.
6 The locking system consists of three components, namely a
7 hex-head grub screw 8, a lock stud 9 and PTFE plug 10.

8 The lock stud is cylindrical and flat milled on one side.

9 To mount the milling sleeve 4 on the elongate body 2, the
10 lock stud 9 and grub screw 8 are assembled together
11 flush, and inserted into corresponding holes milled in
12 the elongate body 2 of the tool 1. The milling sleeve 4
13 is then slipped over the body 2 and secured by screwing
14 down the grub screws 8. The lock studs 9 move
15 rotationally by virtue of the screwing of the grub screws
16 8, and as a consequence the lock studs 9 back out into
17 drilled countersunk holes in the milling sleeve 4 which
18 locks the sleeve 4 both axially and rotationally with
19 respect to the elongate body 2. As a consequence, the
20 milling sleeve 4 has no or negligible rotational
21 movement, notwithstanding rotation of the work string. A
22 PTFE plug 10 is then inserted into the hole in the body 2
23 to act as a debris barrier.

24

25 The first upper sleeve 3 which centralises the work
26 string 7 in the wellbore is mounted on the elongate body
27 2 by ball bearings which allow said upper sleeve 3 to
28 rotate relative to the body 2.

29

30 It can be seen from Figure 2 that the lantern 5 which
31 supports the scraper blades sits within a recess in the
32 lower milling sleeve 4. A corresponding recess (not
33 shown) is located on the upper centraliser sleeve. The
34 recess is greater in size than the lantern itself, and as

1 a consequence the lantern 5 can move in a radial
2 direction relative to the work string, but within the
3 limits set by the recesses in the upper centraliser and
4 lower milling sleeves.

5
6 In the preferred embodiment the tool 1 also comprises a
7 means for cleaning the well fluid within the well. The
8 fluid cleaning means may comprise filtration equipment
9 which may be provided in a variety of different
10 embodiments. For example the filtration equipment may be
11 a wire screen which is appropriately sized to prevent
12 particles of debris from passing through the body 2. It
13 will be appreciated that the filtration equipment could
14 also be comprised of, for example, permeable textile or
15 holed tubes or cages. By providing said filtration
16 equipment the tool can filter debris particles from the
17 well fluid.

18
19 The tool 1 may alternatively have a junk-sub 11 to
20 collect debris from the wellbore as shown in Figure 3.
21 In the embodiment shown, the junk sub 11 is positioned
22 close to the milling sleeve 4 and scraper blades 6 and is
23 hence used to collect debris which is liberated into the
24 annulus of the casing or liner.

25
26 The advantage of the present invention is that the time
27 taken for finishing a wellbore can be greatly reduced as
28 there is no need to implement complex and timely
29 retrieval operations to recover a milling or scraping
30 apparatus from the bore prior to running the other of the
31 milling or scraping component to the bore. As a
32 consequence, profitable production can be begun much
33 sooner. In particular, the tool of the present invention
34 allows the liner top polished bore receptacle within a

1 wellbore to be "dressed off" at the same time as the
2 casing above the liner top is scraped and cleaned. This
3 allows the finished wellbore to be cleaned to remove
4 obstructions such as burrs or lumps of cement, and to
5 smooth entry into the liner top. In the present
6 invention this combination of scraping and milling can be
7 carried out at the same time, and any debris dislodged by
8 said actions will be removed from the well fluid by the
9 filtration equipment or junk sub. There is therefore no
10 need to run a second fluid cleaning tool into the
11 wellbore after milling and scraping.

12

13 In addition, as the scraping members are positioned in
14 close proximity to the milling sleeve, it is possible to
15 set up a packer very close to the polished bore
16 receptacle, in order to isolate a section of the
17 wellbore.

18

19 Further modifications and improvements may be
20 incorporated without departing from the scope of the
21 invention herein intended. For example, the scraper
22 blades may be replaced with other cleaning members as are
23 known in the art eg brushes.

1 CLAIMS

2

3 1. A downhole tool for mounting on a work string, the
4 tool comprising an elongate body having a plurality
5 of cleaning members, and wherein the tool also
6 comprises means for milling casing or liner.

7

8 2. A downhole tool according to Claim 1 wherein the
9 tool also comprises means for cleaning well fluid.

10

11 3. A downhole tool according to Claim 2 wherein said
12 means for cleaning well fluid is a junk basket.

13

14 4. A downhole tool according to Claim 2 wherein said
15 means for cleaning well fluid may be filtration
16 equipment.

17

18 5. A downhole tool according to any preceding Claim
19 wherein the cleaning members are scraper blades.

20

21 6. A downhole tool according to any preceding Claim
22 wherein the tool has a first and second sleeve.

23

24 7. A downhole tool according to Claim 7 wherein the
25 first sleeve is a centraliser sleeve and acts as a
26 stabiliser for the work string within a wellbore.

27

28 8. A downhole tool according to Claim 6 or 7 wherein
29 the second sleeve is a milling sleeve.

30

31 9. A downhole tool according to any one of Claims 6 to
32 8 wherein the tool has a floating component located
33 between said first and second sleeve, the floating
34 component is free to move in a radial direction

1 relative to the elongate body within predetermined
2 limits set by the first and second sleeve.

3

4 10. A downhole tool according to Claim 9 wherein the
5 first and second sleeve have female receiving means
6 for receiving the floating component.

7

8 11. Claim 10 wherein the plurality of cleaning members
9 are supported on the floating component.

10

11 12. A downhole tool according to any one of Claims 7 to
12 11 wherein the centraliser sleeve is mounted by ball
13 bearings that allow for the work string to rotate
14 relative to the sleeve.

15

16 13. A downhole tool according to any one of Claims 8 to
17 12 wherein the milling sleeve is mounted by one or
18 more lock studs that lock the milling sleeve both
19 axially and rotationally with respect to the
20 elongate body.

21

22 14. A method of cleaning and milling, casing or liner
23 within a wellbore, the method comprising the steps:

24

25 a) locating in the wellbore a tool having cleaning
26 members and a milling surface; and

27

28 b) moving the tool relative to the casing or liner
29 to effect the dual action of cleaning and
30 milling.

31

32 15. The method of Claim 14 including the step of
33 cleaning well fluid in the wellbore.

34

1 16. The method of Claim 14 or Claim 15 including the
2 step of collecting debris during the cleaning and
3 milling action.

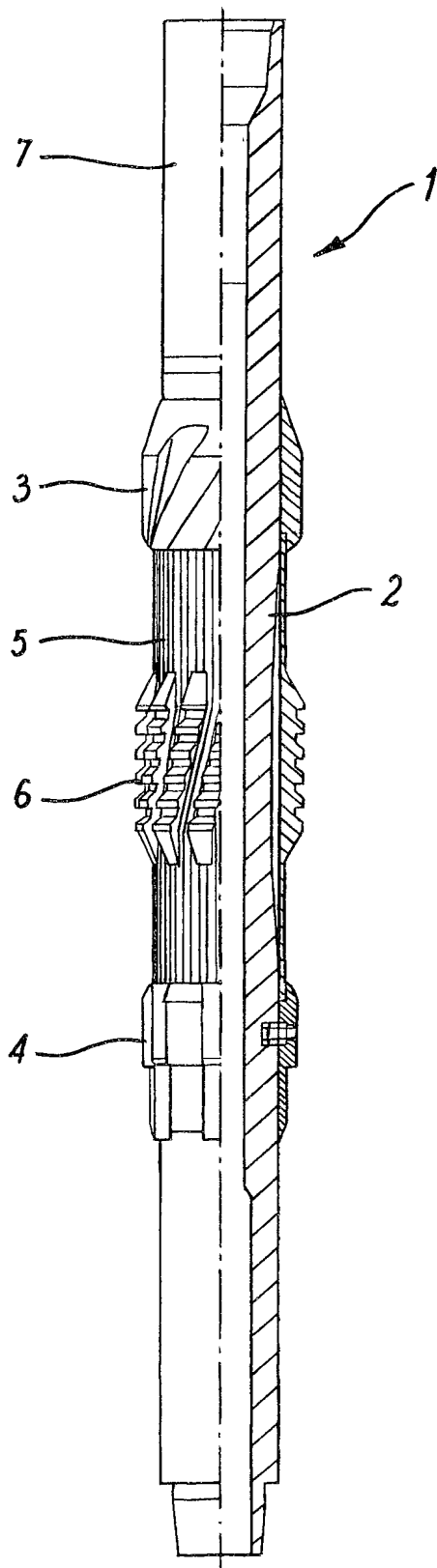


Fig. 1

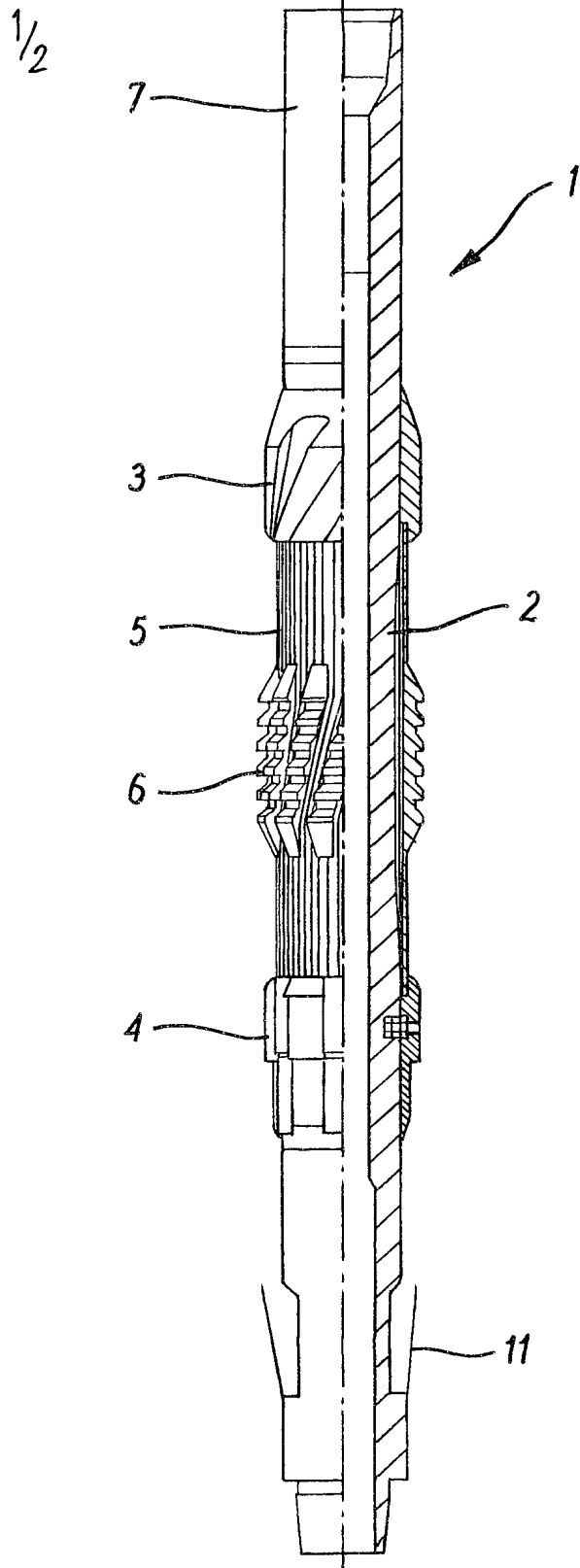


Fig. 3

2/2

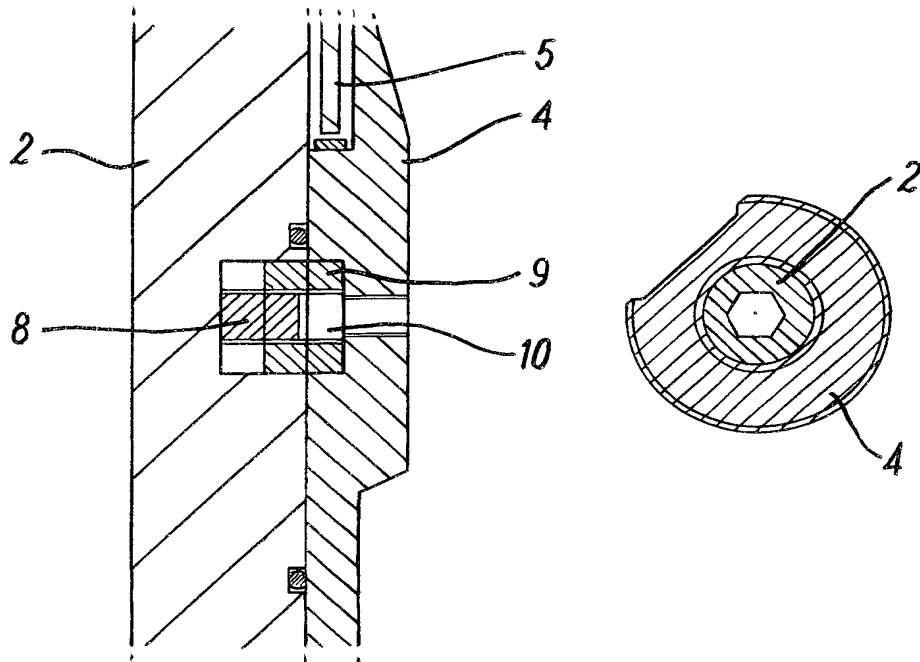


FIG. 2

INTERNATIONAL SEARCH REPORT

Intern al Application No

PCT/GB 01/04742

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 E21B37/02 E21B27/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00 58602 A (FRENCH CLIVE JOHN ;FRENCH OILFIELD SERVICES LTD (BE)) 5 October 2000 (2000-10-05)	1-8, 14-16
Y	page 11, line 3-20 page 16, line 18 -page 22, line 15; figures 1-9 page 13, line 17- -page 14, line 13 ---	9-13
Y	GB 2 340 862 A (SPECIALISED PETROLEUM SERV LTD) 1 March 2000 (2000-03-01) page 8, line 10-29; figures 1-7 ---	9-12
P,Y	WO 01 63087 A (EDDISON ALAN MARTYN ;ANDERGAUGE LTD (GB)) 30 August 2001 (2001-08-30) page 8, line 8-18; figures 1-3 --- -/--	13



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

28 February 2002

Date of mailing of the international search report

07/03/2002

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

van Berlo, A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/04742

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 798 246 A (BEST DAVID M) 17 January 1989 (1989-01-17) figure 9 ----	13
A	US 4 603 739 A (KRUGH MICHAEL E) 5 August 1986 (1986-08-05) figures 1-6 ----	1
A	WO 98 35131 A (TELFER GEORGE ; LUCAS BRIAN RONALD (GB); WEATHERFORD LAMB (US)) 13 August 1998 (1998-08-13) figure 13 ----	1
A	US 3 199 599 A (KAMMERER JR ARCHER W) 10 August 1965 (1965-08-10) figures 1-3 ----	13
A	US 4 189 000 A (BEST DAVID M) 19 February 1980 (1980-02-19) figures 1-4 -----	13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 01/04742

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 0058602	A	05-10-2000	AU 3974400 A EP 1165935 A1 WO 0058602 A1	16-10-2000 02-01-2002 05-10-2000
GB 2340862	A	01-03-2000	NO 993998 A US 6152220 A	22-02-2000 28-11-2000
WO 0163087	A	30-08-2001	AU 3396101 A WO 0163087 A1	03-09-2001 30-08-2001
US 4798246	A	17-01-1989	NONE	
US 4603739	A	05-08-1986	US 4515212 A	07-05-1985
WO 9835131	A	13-08-1998	AU 730038 B2 AU 5671498 A EP 0960263 A2 WO 9835131 A2 NO 993500 A	22-02-2001 26-08-1998 01-12-1999 13-08-1998 04-10-1999
US 3199599	A	10-08-1965	NONE	
US 4189000	A	19-02-1980	NONE	